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University of Tripoli – Faculty of Engineering

Electrical & Electronic Engineering Department

EE463 **Final Exam** **Time: 2 hr** **Spring 2017** **3/2/2018**

Q1) Temperature sensor sensitivity is 4Ω/°C, in the range (±25°C) and its value at 0°C is 280Ω. Using Wheatstone bridge convert its range to volt, and send its value using (4mA –20mA transmitter) and prepare it for 8bit ADC with voltage reference 0-5Vref.

a) What is the digital output of ADC at the temperature -2 °C. [12 pts]

Q2) Accelerometer sensor sensitivity is 0.33mA/g, used for measuring Acceleration in the range (± 20 g). Design signal condition circuits for bipolar (8 bit) ADC with voltage reference ±4V.

a) What is the digital output of ADC at the acceleration is -3 g. 112

b) What is the acceleration when the digital output is 06H. -19 [12 pts]

Q3) Design the signal conditioning circuits to connect the sensor to 10 bit ADC with voltage reference (0-5V), where: sensor output range (-150 – +150 mV) with frequency 15Hz. Noise signal 20mV with frequency 150Hz, and design filter that Attenuate the noise signal to 25%, and taking in account the effect of the filter on the sensor signal. [10 pts] V_o = V_i 17.[illegible]2 ×25

V_M

Q4) Using Thermocouple sensor Type J with 0°C reference, find the value of its output at 32°C. Design circuit to operate cooler if the temperature is more than 32°C, and using RTD with the following table using linear approximation of resistance versus temperature find the value of the RTD at 13°C and design circuit operate heater if the temperature is less than 13°C. [12 pts]

RTD = 11[illegible].25

V_M = 1.936 mV

Temperature (°C)	0	5	10	15	20
Resistance (Ω)	107.6	109.1	110.2	111.1	111.7

Q5) What is the sampling and sample and hold and aliasing and oversampling (Draw as you can) [4 pts]

Good Luck (Zeyad)

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Q4) Thermo Couple Sensor Type J with 0°c ref

O/P if $T = 32°c$ to operate Coller ~~at 32°c~~ $T > 32°c$

using RTD with Table using linear approximation

RTD ?! at 13°c

- operate heater if $T < 13°c$

T	0	5	10	15	20
R	107	109.4	110.2	111.1	111.5

$V_L = 1.54$ mv $T_L = 30°$

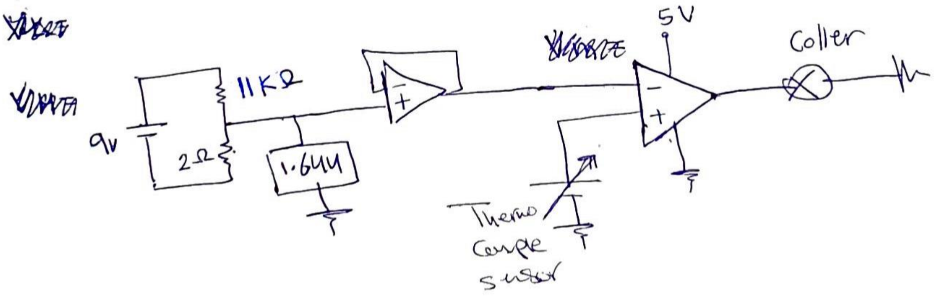
$V_H = 1.80$ mv $T_H = 35°$

$T_m = 32°c$

$$V_m = V_L + \left[\frac{V_H - V_L}{T_H - T_L}\right](T_m - T_L)$$

$$= 1.54 + \left[\frac{1.80 - 1.54}{35 - 30}\right](32 - 30)$$

$$V_m = 1.644$$


5V
Coller
11KΩ
9v
2Ω
1.644
Thermo Couple sensor

$$9 \times \frac{R}{11K\Omega + R} = 1.644 \text{ mV}$$

$R = 2\Omega$ #

$T_1 = 0$, $R_1 = 107$

$T_0 = 10$, $R_0 = 110.2$

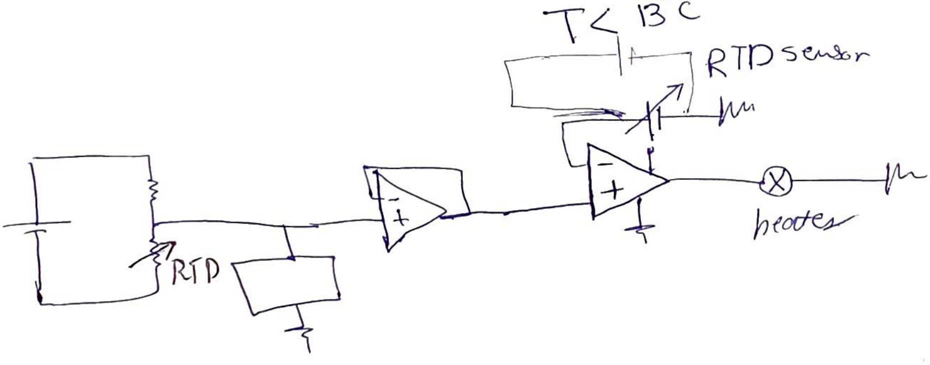
$T_2 = 20$, $R_2 = 111.5$

$$\alpha_0 = \frac{1}{R(T_0)} \times \frac{R_2 - R_1}{T_2 - T_1} = \frac{1}{110.2} \times \frac{111.5 - 107}{20 - 0} = 2.041 \times 10^{-3}$$

$$R(T) = R(T_0)(1 + \alpha_0 \Delta T)$$

$$= 110.2 \, [1 + 2.041(13 - 10)]$$

$$= 110.87 \, \Omega$$


T< 13°C
RTD sensor
RTD
heater